FIRE PROTECTION AND SAFETY:
THE NEXT 25 YEARS

A White Paper Report for the

Fire Protection Research Foundation
"Next 25 Years Conference"

held on
November 17 & 18, 2008
at the
Ronald Reagan Building, Washington, DC

Conference hosted by, and Report prepared by:

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FOREWORD

On November 17 and 18, 2008, approximately 130 fire protection and safety professionals gathered in Washington, DC for a unique meeting. This conference, titled "Fire Protection and Safety: Preparing for the Next 25 Years" (referred to herein as the "*Next 25 Years Conference*"), was hosted by the Fire Protection Research Foundation to celebrate the completion of its 25th year of service.

Speakers, panelists and attendees, representing the leadership of the fire protection community, provided thought provoking perspectives that provided a glimpse of where we may be heading. The one and one-half day meeting was held in the Rotunda of the Ronald Reagan Building in Washington DC. Nationally recognized keynote speakers challenged the conference participants on the emerging demographic, technological, and environmental issues facing us.

This White Paper Report documents and summarizes the applicable activities occurring prior to the conference, the conference itself, and certain activities that followed the conference that add to its value. Significant preparation has gone into the planning of this event, including informal information gathering from several groups of the Fire Protection Research Foundation and the National Fire Protection Association. Likewise, feedback was provided by some attendees after the conference, and this is similarly included herein.

The conference and this White Paper Report represent an exercise that takes stock of today's fire protection approaches, and attempts to provide some indication of what challenges we will face in the next quarter of a century. As the Fire Protection Research Foundation implements its mission to plan, manage, and communicate research on a broad range of fire safety issues, it hopes that all the participants in this initiative and all who use this White Paper Report will join together to utilize its value.

The information contained in this White Paper Report is based on the input of numerous fire protection professionals. While considerable effort has been taken to accurately document this input, the final interpretation of the information contained herein resides with the author.

ACKNOWLEDGEMENTS

This initiative has been a collective effort involving the input and support of various individuals, organizations and groups within the fire protection community, and the Fire Protection Research Foundation would like acknowledge the support provided.

The conference has been made possible through generous financial support from the

National Fire Protection Association

Appreciation is likewise extended to the organizations that assisted by sponsoring certain details of the Conference:

FM Global
Honeywell Life Safety
SimplexGrinnell
Tyco Fire Suppression and Building Products
Underwriters Laboratories Inc.

Planning for this project has taken place over the course of the preceding year with a planning committee assisting Foundation staff. Special thanks are extended to the members of the planning committee comprised of the following:

Conference Planning Committee
April Leyla Berkol, New York NY
J. Thomas Chapin, Underwriters Laboratories Inc, Alpharetta GA
Philip J. DiNenno, Hughes Associates Inc, Baltimore MD
Kenneth W. Dungan, Risk Technologies LLC, Knoxville TN
Gene Eckhart, National Association of Electrical Manufacturers, Rosslyn VA

This report has been prepared by Casey Grant, Program Director for the Fire Protection Research Foundation, with assistance from Kathleen Almand, the Research Foundation's Executive Director. Special thanks are extended to Diana Wamakima of the National Association of State Fire Marshals for her assistance recording the event.

TABLE OF CONTENTS

1) INTRODUCTION AND BACKGROUND

"Prediction is very difficult, especially about the future."
Niels Bohr
Danish physicist (1885-1962)

This white paper documents the activities before, during, and after a unique one and one-half day conference of fire protection and safety professionals looking 25 years into the future. How did this unique meeting and all the related before and after activities come to occur? The genesis of this initiative follows.

The Fire Protection Research Foundation was created in 1982 by the NFPA Board of Directors to address the growing need for an organizational resource to enhance the technical basis of NFPA's codes and standards. Originally called the National Fire Protection Research Foundation (NFPRF), the Foundation was registered in Washington, DC as an independent 501(c)(3) corporation. John Gerard, who was managing NFPA's Washington Office at the time, was appointed NFPRF Executive Director.

In 1983, with the Foundation now an independent registered organization, the offices were relocated to NFPA headquarters in Quincy, Massachusetts. Rick Mulhaupt joined the Foundation in 1983, serving for more than two decades as its president until 2004. During the Foundation's first two decades, the name was changed to the "Fire Protection Research Foundation". In 2005 Kathleen Almand assumed the role of Foundation Executive Director, and she continues in that position today. During this transition period the mission statement of the Foundation was revised, and today it is "to plan, manage, and communicate research in support of the NFPA mission."

To celebrate its 25th anniversary, several events and activities were planned in 2007 and 2008 to recognize and provide tribute to the Foundation's extensive contributions over the last quarter of a century, and also help clarify the Foundation's role going forward into the future. For example, included were several retrospective articles published in NFPA Journal, and a reception held at the NFPA Annual Meeting in June 2008.

Planning for a special conference as part of this celebratory spirit started in 2007, and the intent was to hold the event later in 2008 to recognize the 25 years of service provided by the Fire Protection Research Foundation. However, early on it was decided that rather than continue to look back and reminisce on past accomplishments, instead this conference would look forward to the next 25 years.

A planning committee of comprised five respected and dedicated volunteers assisted Foundation management and staff with the clarifying the direction and details of the

conference, and early in 2008 the basic objectives were established. The members of the planning committee were: April Leyla Berkol (New York, NY); J. Thomas Chapin, Underwriters Laboratories Inc (Alpharetta, GA); Philip J. DiNenno, Hughes Associates Inc (Baltimore, MD); Kenneth W. Dungan, Risk Technologies LLC (Knoxville, TN); and Gene Eckhart, National Association of Electrical Manufacturers (Rosslyn, VA).

The full title of the conference was aptly chosen to be "Fire Protection and Safety: Preparing for the Next 25 Years", and is also referred to by the abbreviated title as the "*Next 25 Years Conference*". On November 17 and 18, 2008, more than 130 leaders from the research, engineering, fire service, facility fire protection and manufacturing fields attended the conference in the Rotunda of the Ronald Reagan Building in Washington DC to help celebrate the Foundation's 25th anniversary by looking toward the future and the possible challenges of tomorrow. A full list of the participants and attendees is included in this report as Annex A.

To provide structure for the event, planning ultimately evolved around three basic topic areas of focus, each of which included a keynote presentation, a diverse set of panelists who each provided brief presentations, and an open discussion of the topics with attendees. These three basic topic areas provided the backbone for the one-and-a-half day conference, and were:

- Session Topic 1: Demographics and Urban Growth Patterns
  (Future Fire Protection: the Social and Demographic Context)
- Session Topic 2: Materials and Technology
  (Tomorrow's Materials and Technologies and Fire Safety)
- Session Topic 3: Environment, Energy, and Sustainability
  (Tomorrow's Sustainability Challenges and Fire Safety)

While the Fire Protection Research Foundation is entering its second quarter century of service to the fire protection community, the NFPA was established 112 years ago and is among the established leaders for facilitating fire safety efforts worldwide. The Research Foundation operates as an affiliate of the NFPA, and both organizations have a long and proven track record to support their respective missions of making the world safer from fire and related hazards.

The Research Foundation and the NFPA have accomplished much in terms of the betterment of today's world. NFPA is an international nonprofit membership organization founded in 1896, and today, with more than 81,000 members representing nearly 100 nations and 320 employees around the world, NFPA serves as the world's leading advocate of fire prevention and is an authoritative source on public safety. NFPA's 300 codes and standards influence virtually every building, process, service, design, and installation in the United States, as well as many of those used in other countries.

A key mechanism used by the NFPA to achieve its mission is its codes and standards process, which is driven by more than 7,000 volunteers from diverse professional backgrounds who serve on almost 300 Technical Committees. Some of these committees have been active since

NFPA’s inception in 1896, and they revise their respectively assigned documents on a continual revision cycle every 3 to 5 years. The Research Foundation’s partnership with NFPA has provided practical, usable data on fire and building safety, and brings premier fire research resources to experts in code, corporate, and government arenas through objective research documentation on today's crucial fire problems.

2) PRE-CONFERENCE INFORMATION GATHERING

"The empires of the future are the empires of the mind."
Sir Winston Churchill
British Prime Minister (1874 - 1965)

The conference that is the primary focus of this white paper report was held in late November 2008 in Washington, DC. Meetings of this type require in-depth planning, and this particular conference was no exception.

In addition to the normal logistical planning for the event, other content-oriented information gathering efforts also occurred. These activities preceded the meeting and provided useful preliminary information that helped shape the tone of the conference discussions and facilitated some of the concepts that were ultimately addressed.

Research Foundation staff has traditionally worked with various constituent groups to address short and long term research planning needs, and the approaching *Next 25 Years Conference* provided an additional focus for this on-going effort. Research planning is inherently based on what is needed for the future, and thus separate meetings with certain individual technical committee projects and others were helpful for building an intellectual mindset of where we are heading and what we need to do. Specifically, Foundation staff was able to work with six different groups, including NFPA Technical Committee Stall Liaisons (see Annex B), to gather helpful planning information to address where we expect to be heading in the future.

The venue for each of these groups differed depending on the circumstances. Several of these involved full one day meetings devoted to identifying research needs and planning for the future, while others involved several hours carved out of an NFPA Technical Committee meeting due to limited available time. The following is a brief summary of each meeting:

a) Automatic Sprinkler Systems. The Automatic Sprinkler Fire Protection Research Council held a one-half day planning meeting on 22 September 2008 and generated a list of 30 topics covering the categories of residential, special applications, design/modeling, general storage, and special subjects.
b) Fire Alarm, Signaling and Notification. Multiple lines of input were received starting with the Fire Detection and Alarm Research Council that met in 2007 and 2008 and generated a list of 11 research topics. This was followed by a special evening meeting held with members of the NFPA 72 (National Fire Alarm Code) project to review possible future issues at their meeting in Birmingham, AL on 22 October 2008, where they generated a summary of 12 research topics addressing the following topic areas: Detection, General Technology/Component/System Improvements, Notification, and Infrastructure Improvements.

c) Fire Service Personal Protective Equipment. A planning meeting was held with a task group of the NFPA Fire and Emergency Service Personal Protective Equipment (PPE) Technical Correlating Committee on 29 May 2008 at the NIOSH/NPPTL facility in Bruceton, PA. A prioritized research agenda of 10 topics was generated.

d) Electrical. A one day planning meeting was held with the Advisory Committee on Electrical Safety Research that works in coordination with NFPA electrical related documents, including NFPA 70, *National Electrical Code*. The meeting was held in Baltimore MD on 28 August 2008 and generated a prioritized list of 33 possible research topics for consideration.

e) Hydrogen. Research related to hydrogen is addressed by the Hydrogen Research Advisory Council, and they met in February 2008 to provide a follow-up review of research planning work that was done in 2007. Research topic statements were developed for 27 research projects that would benefit the NFPA hydrogen safety codes and standards, with 11 identified as of highest priority. These were grouped into the following six activity areas: modeling; detection; confinement issues; materials; components; and refueling stations.

f) NFPA Staff Liaisons. A special planning meeting was held with all available NFPA staff liaisons in conjunction with a special update meeting on 27 August 2008 in Quincy, MA. This meeting generated 35 issues that were deemed to be significant and likely to impact NFPA codes and standards in the next 25 years. In recognition of the basic categories that would be used for the *Next 25 Years Conference* in November 2008, these were grouped in the three basic categories of: (a) social and demographic change, (b) changes in materials and technology, and (c) changes in environment, energy and sustainability.

All of this preliminary information was collected, reviewed and discussed by the Foundation's Research Advisory Committee (RAC) before the November 2008 conference. The RAC was formed in 2005 and operates under the auspices of the Research Foundation Board of Trustees. The purpose of the RAC is to provide general oversight for the research programs undertaken by the Foundation to ensure that they support the Foundation's mission.

The RAC discussion focused on the format and priority assignment for a possible strategic research agenda that might encompass this input. Approaches that were discussed and considered were based on:

- research thrust area (e.g. transportation, materials, energy);
- TCC areas (e.g. electrical, sprinkler, alarm);
- protection strategy (sprinklers, fire alarm, structural protection);
- type of project (field studies, hazard assessment); and
- potential impact (on cost, on safety, on standards).

The RAC recommended that approaches should also recognize and be consistent with the overarching areas of: technology; climate change/ globalization; population patterns (and consequent security related issues); resources (water, materials, energy); and aging infrastructure. The value of a strategic research agenda for the Foundation is that it could be

used to prioritize projects when resources are limited, to educate NFPA committees on future trends, and to be proactive in seeking collaborators around major initiatives. These discussions also provided clarification of the elements that need to be considered when attempting to provide details on specific proposed research projects.

The results of the *Next 25 Years Conference* are planned to be reviewed by the RAC and the Foundation Board of Trustees at their meetings in 2009. Additional action regarding a possible strategic research agenda will follow at that time.

3) CONFERENCE OVERVIEW

"The future is here. It's just not widely distributed yet."
William Gibson
American-Canadian author (1948 -)

To help prepare for the next 25 years, fire protection and fire safety leaders gathered for the *Next 25 Years Conference* hosted by the Fire Protection Research Foundation on November 17-18, 2008 at the Ronald Reagan Building in Washington, DC. The one-and-a-half days of meetings included keynote speakers and panel sessions on the following three primary topics areas:

- Future Fire Protection: the Social and Demographic Context (Section 5)
- Tomorrow's Materials and Technologies and Fire Safety (Section 6)
- Tomorrow's Sustainability Challenges and Fire Safety (Section 7)

The conference featured a series of keynote speakers from outside the fire protection community who set the stage with anticipated major changes in the societal, technological and environmental context; panels of industry leaders then presented their views on the impact of these changes on fire safety. Special Topic Speakers were:

- James M. Shannon, President, National Fire Protection Association and Chairman, Fire Protection Research Foundation Board of Trustees
- Craig Beyler, Ph.D., Hughes Associates, Inc. and Chairman, International Association of Fire Safety Science
- Kathleen Almand, Executive Director, Fire Protection Research Foundation

Each of the three primary topic areas was addressed separately, with each anchored with a keynote presenter who provided a detailed overview of the topic. These were followed by a panel discussion, with each panelist first providing a short presentation, followed by questions and answers with all attendees. The following lists the speakers in each of the three sessions:

Session One: "Demographics and Urban Growth Patterns"
Keynote Presenter:

- Kevin McCarthy, Ph.D., Senior Social Scientist, RAND Corporation

Panelists:

- Fred Mowrer, University of Maryland (session one moderator)
- Stacy Welch, Marriott Corporation (building owner/operators perspective)
- Kathy Ann Notarianni, Worcester Polytechnic Institute (academia perspective)
- Ozzie Mirkhah, Las Vegas Fire and Rescue (fire officials perspective)
- William Koffel, Koffel Associates (fire protection engineers perspective)
- Paul Hough, Armstrong World Industries (building products industry perspective)
- Larry McKenna, U.S. Fire Administration (federal fire service perspective)

Session Two: “Materials and Technology”

Keynote Presenter:

- Philip Anton, Ph.D., Director, Acquisition and Technology Policy Center, RAND Corporation

Panelists:

- Greg Monty, Underwriters Laboratories, Inc (session two moderator)
- Robert Boyer, GE Fire and Security (fire alarm industry perspective)
- John Dean, State of Maine (state fire marshals perspective)
- Russ Fleming, National Fire Sprinkler Association (fire protection engineers perspective)
- Anthony Hamins, National Institute of Standards and Technology (federal government research perspective)
- Bob Khan, Phoenix Fire Department (metropolitan fire chiefs perspective)
- Ian Stronach, Rio Tinto (building owner/operator perspective)

Session Three: “Environment, Energy, and Sustainability”

Keynote Presenter:

- Shere Abbott, Director, Center for Science and Practice of Sustainability, University of Texas at Austin

Panelists:

- Carl Baldassarra, Schirmer Engineering Corporation (session three moderator)
- Ed Altizer, State of Virginia (state fire marshals perspective)
- James Golinveaux, Tyco Fire and Building Products (water based suppression industry perspective)
- Jon Hall, FM Global (insurers perspective)
- Jim Pauley, Schneider Electric (codes and standards perspective)
- Bill Stewart, Toronto Fire Services (metropolitan fire chiefs perspective)
- Ian Thomas, Victoria University(academia perspective)

4) CONFERENCE SPECIAL PRESENTATIONS

"It is not possible to properly summarize the magnitude of Professor Emmons' unique contributions to the establishment of fire safety science as a discipline, other than to call him 'Mr. Fire Research'."

Patrick Pagni

Professor Emeritus, University of California at Berkeley (1933 -)

Aside from the keynote speakers and panelists in each of the three primary topic areas of the *Next 25 Years Conference*, three additional speakers also made special presentations. These were not part of the three topic areas that are addressed in detail in Sections 5, 6, and 7 of this White Paper Report.

Special presentations not part of the three primary main topic areas of the conference program included the opening remarks at the start of the conference and closing remarks at its conclusion; these were made by both NFPA President James Shannon and Fire Protection Research Foundation Executive Director Kathleen Almand. The other presentation not part of the three topic areas was a special presentation by Dr. Craig Beyler, who provided a retrospective on the visionary predictions of the late Dr. Howard Emmons, one of the premier leaders of our profession.

Kathleen Almand officially opened the conference by introducing Jim Shannon, President of the National Fire Protection Association. In his opening remarks for the conference, Jim welcomed all the attendees and participants to what would be a "think-big" conference. He indicated that the purpose of the meeting was not to look back, but to look ahead to the next 25 years, and he did so by posing the questions: how should we prepare for future challenges?

Jim described some of the past accomplishments of the Foundation including research to support the use of alternatives to environmentally harmful halon fire extinguishers, new sprinkler technology, and detection systems. These accomplishments were used as a backdrop to update the conference attendees on the recently announced creation of a $6 million endowment for the Research Foundation, which will ensure its future role in facilitating research in support of enhancing the technical basis of NFPA's codes and standards. He challenged participants to focus on the problems that we have today and what they will mean for the next generation.

As the participants in the conference reflected on future trends and their impact for fire safety, Dr. Craig Beyler, Technical Director, Hughes Associates, Inc., presented a retrospective on the vision of the 21st century from one of our profession's leaders – the late Dr. Howard Emmons (1912-1998), Harvard University professor and one of the fathers of the field of fire safety

science. Professor Emmons mentored fifty PhD students in the area of combustion and fire and influenced countless others. Dr. Beyler has the distinct honor of being his last Ph.D. student.

Twenty-five years ago, Emmons predicted the future state of our ability to evaluate fire risk and associated mitigation strategies. He was optimistic about our continued abilities to move toward performance based design but reflected that modeling and engineering enhancement will not have nearly as much impact on safety as other external issues, such as those discussed in this conference.

Howard Emmons was an icon in our profession, with many contributions to the scientific body of knowledge in the fire protection community. Among his contributions, and the focus here, are his extensive and detailed visions and predictions of the future of fire protection engineering and the science of fire. Emmons had numerous published papers where he provided a glimpse into the future, but most notable were 6 specific publications, including a key article in 1984. These were his most prominent visionary science papers.

The growth of modern fire science can be traced to the early 1950s, and Emmons was in the middle of all of this. He was looking ahead and was ahead of his time. He could see that our design world needed to be more performance oriented, and that greater science needed to be applied. Limitations of the day included the necessary computer hardware and this needed to be overcome.

Dr. Emmons provided numerous short term predictions with a focus on a specific year. For example, in 1991 he observed that some areas had “settled science”, such as structural codes and sprinkler design codes, since they only required verification because the physics are relatively settled. In fire, the computational models are not based on settled science, and this was still years off. Today, model authors are writing validation reports, but Emmons thought these should be done by other than the authors. He outlined strategies for the implementation of performance based codes, which are still open questions today.

Looking ahead toward the long term, Dr. Emmons was bold enough to try and predict the more distant future. He initially focused on 2010 and 2020. An example of his forward vision is his prediction of mineral based synthetic foam as a 2025 fire protection material. For the period between the years 2030 to 2080, he provided a vision of the new fire protection tool box. His predictions extended several hundred years into the future, and for example he indicated that in 2300 fire protection engineering would be a fully mature discipline.

Dr. Beyler offered some thoughts on all these predictions, and where are we’re headed. For example, with fire modeling, there is no focus on an approach where practical models are used and tested against a precision model. For performance based design, Dr. Emmons thought that this would evolve around a single computer model, but that is not happening. Dr. Emmons was concerned with excessive government control on the fire codes, but this has evolved to be a non-issue. He also indicated that the demise of cheap petroleum products will drive change, but this is not necessarily the case.

Dr. Beyler summarized by indicating that, in terms of future progress, the research community doesn't have the same level of resource commitments we had in the 1970's. However, the current endowment from NFPA to FPRF is a positive sign, and this is important. The FPRF is an integral part in the process to more forward, though other organizations will need to be part of this equation.

In her concluding remarks, Kathleen Almand, Executive Director of the Foundation, reviewed the process for synthesizing the information being gathered before, during, and after the conference, and how it will serve the fire protection community in terms of providing a strategic framework. Importantly, Kathleen challenged the conference participants to work with the Foundation to address fire safety in the context of the *Grand Challenges* and opportunities facing our society and to shape the Foundation's research direction as it begins its second 25 years.

The concept of *Grand Challenges* was addressed in detail by Kathleen, and served as a call-to-arms for the fire protection and safety community. A *Grand Challenge* by definition is ambitious, although its subject may be mundane (for example, the challenge to develop vaccines that don't require refrigeration). It can be described in a sentence or two that all can understand, and one can simply define its importance and benchmarks for success. The concept of *Grand Challenges* has since been adopted today in a variety of fields to draw attention and resources to problems that, if solved, could lead to major advances.

Credit for coining the term *Grand Challenge* is given to a famous 19th century mathematician, David Hilbert, who developed significant portions of the mathematical infrastructure required for quantum mechanics and general relativity. In his 1900 retirement lecture at the World Conference of Mathematicians in Paris, Hilbert outlined 23 *Grand Challenges* in mathematics (fundamental unsolved problems) for his successors to solve. The worldwide mathematics community rose to address these challenges, and within 20 years all but one, the Reimann hypothesis (still unsolved today), were solved.

In similar fashion, Kathleen asked the conference attendees to think about the GRAND CHALLENGES for fire safety as we look to the next 25 years. The role for the Foundation will be to distill and transform the information gathered during the Foundation's anniversary year and from this conference into a framework of GRAND CHALLENGES so that we can focus the energies and resources of our community to address them. We'll need to work together to address these grand challenges going forward in the next 25 years.

The official adjournment and final word of the conference was provided by NFPA President Jim Shannon. He mentioned that the NFPA and the Research Foundation have always found a way to bring the right people together to get the right answers to solve our collective problems, and this is what we've seen at this conference. In closing he stated that this had been an extraordinary meeting, and in its own way signaled a new beginning for us all.

5) SESSION TOPIC 1: DEMOGRAPHICS AND URBAN GROWTH PATTERNS

"Civilization begins with order, grows with liberty, and dies with chaos."
Will Durant
American philosopher (1885 - 1981)

Session One Keynote Presentation

The keynote presentation of the first topic area on "Demographics and Urban Growth Patterns" was presented by Dr. Kevin McCarthy, Senior Social Scientist at the RAND Corporation. He addressed demographic and urban growth patterns and how they will impact future fire safety.

Dr. McCarthy provided the context for examining the influence of demography on future fire protection by addressing four key features of U.S. population: 1) size/growth, 2) geographic distribution, 3) composition (age, ethnicity, and household composition), and 4) labor force behavior. He indicated that the U.S. population will steadily grow over the next 25 years by about 1 percent or about 3 million people per year, and immigration will account for 40% of that growth. Population increase will primarily occur in six southern and western states (with the largest growth in Arizona, Florida, Nevada, and North Carolina) and will be increasingly concentrated in urban areas. Notably, these are areas that are also at risk to certain large-scale man-made and natural disasters (e.g., wildland fires, hurricanes, earthquakes, etc).

The composition of the U.S. population is also changing. The median age of the population will grow from 35 to 38 years with a corresponding shrinkage in the working population and growth in the senior population, the latter from 12.5 percent to 20 percent. What this means is that while the population is expanding the labor force will be growing more slowly. These factors together will result in more single person households, and fewer households with children, resulting in shifting changes in housing type. The Asian and Hispanic proportion of the U.S. population will grow from 22% to 34%, which will be comprised of immigrants. This will define certain cultural characteristics that will impact the fire service, such as the effectiveness of fire safety education and enforcement programs, or possible changes in volunteer fire fighter recruitment efforts.

The presentation by Dr. McCarthy posed the following question to the conference attendees: "What are the impacts for fire safety?" This was subsequently addressed by the conference panelists, who agreed that the aging and consequent increasingly disabled population will impact needed building fire protection features. Concentrations of population will result in demands for fire protection services, and the infrastructure (for example water, roads) needed to support them. Public fire safety education programs will need to adjust to the change in demographics, including cultural and language changes. Finally, the decline in the labor force

as a percentage of the overall population will require that we effectively use our human resources for fire safety through, for example, targeted allocation and collaboration.

Session One Keynote Speaker Question and Answer Dialogue

Question: The South and West may have water issues. What will this do to population growth?
Dr. McCarthy: Good case study here is the water supply problems of California. If access to available water declines, for political reasons, it will put real constraints on growth. But these can be based on political issues rather than resource availability issues. FL, for instance, has a different water supply problem. This can make a difference in states like AZ and CA, but other things can be done to overcome these problems.

Question: With the population becoming older, will educators be addressing this, and can those promoting fire protection do likewise?
Dr. McCarthy: Another good example is what California is going through to address moving populations from wildland urban interface fires. People need to be better tuned in to how they want to allot their resources. Public education tasks have always been challenging, and the public needs to think other than short-term.

Question: The growing Hispanic population in California is shifting the culture, and this has resulted in an increasing distrust of government. Getting them help and educating them on fire problems is a cultural issue, not a language issue.
Dr. McCarthy: For situations like this, it may be better to work with such groups through other means, such as church groups that they do trust. A public education role will be critical to help shape public attitudes. San Diego County is going through this now, where despite serious wildland damaging fires, the residents still won't support the needed resources.

Question: How well does the sphere of demographics for where we are today project out for the next 25 years.
Dr. McCarthy: Generally, if you look at broader trends, two important trends are the growth of older households, and expansion of consolidated settlement patterns. States differ significantly in regional planning. Looking out for the long term is always a challenge, but the trends are there.

Question: Are you taking somewhat of an elitist position, when in fact people's opinion may be very different?
Dr. McCarthy: I'm less persuaded by culture, since people are reasonable and can adapt. Public policy analytical thinkers are good at laying out the options and possible actions, but it's up to the political leaders to make the value judgments and make the tough decisions.

Question: Want to address the growing older population. The numbers are so huge, how will we absorb them?

Dr. McCarthy: We need allies, such as insurance groups, who will have the same basic goals and incentives. We should be working closely with groups like AARP and others.

Question: What about financial growth rate, and how it relates to the elderly?
Dr. McCarthy: The population growth is not distributed evenly across all age groups. This is a constraint, but it doesn't dictate the economy. Growth is dependent on multiple factors. What we do best and how we adapt are important questions. The focus of public policy analysts is mostly short term details, usually to support policy arguments that are already established. Politicians generally have term limits, and therefore they usually want results that will support their previous decisions.

Question: Will we have a population drop like Japan, from 120 million to 90 million, since it is immigration dependent and not mortality dependent.
Dr. McCarthy: For some cultures, like in Japan, it is very hard for non-Japanese to assimilate into the native population. In the U.S., immigration is the primary driver, and many other factors will provide influence.

Session One Panel

After the presentation by Dr. McCarthy, the panelists for conference session one addressed the first primary topic area on "Demographics and Urban Growth Patterns". The panel was moderated by Dr. Fred Mowrer from the University of Maryland, and the panelists were:

- Stacy Welch, Marriott Corporation (building owner/operators perspective)
- Kathy Ann Notarianni, Worcester Polytechnic Institute (academia perspective)
- Ozzie Mirkhah, Las Vegas Fire and Rescue (fire officials perspective)
- William Koffel, Koffel Associates (fire protection engineers perspective)
- Paul Hough, Armstrong World Industries (building products industry perspective)
- Larry McKenna, U.S. Fire Administration (federal fire service perspective)

Each panelist provided a brief 10 minute overview of their perspective relating to the session one topic of demographics and urban growth patterns. The following provides a summary of the key points made by each presenter:

a) Stacy Welch, Marriott (a building owner/operators perspective).
   - Buildings are more complex than they've ever been before, and in the most congested areas.
   - Have concern with evacuating building occupants, and especially older populations.
   - Fire prevention is an important topic, and is fragmented across the country.
   - Need increased research on behavioral issues.

b) Kathy Notarianni, WPI (an academia perspective).
   - Education is important and should adapt to changes in demographics, which is destiny.

- Focus needs to include public policy in addition to traditional engineering.
- We need partnerships and customized solutions.

c) Ozzie Mirkah, Las Vegas Fire & Rescue (a fire official's perspective).
- Overall fire losses today are significant.
- Engineering alone is not the solution. We need to be better organized on the softer side of science.
- We have a cultural lag trying the address our overall fire problem.
- Organizations need to be re-established and better coordinated to address the overall fire problem.
- We need to address the fire problem at the source, and to work better together.
- We need to better educate the public.

d) Bill Koffel, Koffel Associates (a fire protection engineers perspective).
- The FPE work force of tomorrow is heading in a direction that will soon be depleted; the FPE pool is cycling out and not being replaced.
- Current FPE programs today are not in the high growth areas and need to adapt.
- An important issue is maintenance. We've become a disposable society and need to better sustain what we have.
- FPRF needs to look at how to prepare FPE in 25 years, and how to incorporate maintenance (and sustainability) into the technology we have today.

e) Paul Hough, Armstrong Industries (a building products industry perspective).
- The world is changing and it's a shrinking world, and we anticipate clash and conflict with manufacturers caught in the middle.
- The following trends are important:
  - Boomers are getting older, causing a growing elderly population, in smaller homes that are built more closely together.
  - Design technologies are being exported and imported throughout the world transparently.
  - The movement of populations into the urban/wildland interface is rapidly increasing and creating new challenges.
  - The green movement is becoming widely embraced. Commercial building construction is changing dramatically with the help of LEEDs, and fire protection characteristics are changing.

f) Larry McKenna, USFA (a federal fire service perspective).
- Attitudinal barriers are the biggest challenges to change.
- Population centers are shifting, and elderly housing itself is changing.
- Immigration is changing our fire protection approach, since some new immigrants are not supportive of volunteering and some have inherent fear of uniformed authority.
- Generational differences are significant between younger generations and older generations.

- Energy and technology is also changing. In some cases it will result in safer products and new fire fighting tools, but in other cases it will introduce new hazards.
- Materials and methods are important and their use in building is changing.
- Our approach to public policy is shifting, while limited budgets and resources will test our public policy.

Session One Panel Question and Answer Dialogue

Comment: Have not heard Public Health mentioned at all yet. Show of hands indicates that no other representation at this meeting. APHA needs to meet with the NFPA and others. Need to address the quality of health and aging, and not just more elderly.

Question: Public education is critical. Fire protection needs to parallel the international corrosion community. Funding is certainly important. But while aging population is important, so is the aging infrastructure.
Panel: This will be further addressed in the conference.

Question: From the building owner/operators perspective, how has intelligibility been factored into the concerns with a growing elderly population.
Panel: Yes, this is being looked at, and this is something the hotel industry is trying to address, including dealing with this in places with multiple languages. If some of the people understand, others will follow.

Question: Some societies have much greater emphasis on prevention. Agree with the fire official's perspective that we need improved organizational interaction. Research that academia and others are doing is vital. Currently we have a very small percentage of our resources contributed to solving problems.
Panel: Agree. Don't want to cut back resources, but want some of the focus on research to also be focused toward fire prevention. We should use the grant process itself to help address the fire problem. For example, give advantages for equipment purchases in the AFG program to jurisdictions with residential sprinkler ordinances.

Question: What is the response from the fire service on changing demographics, and what are the research needs?
Panel: there will be a lot of impact on the fire service. Staffing levels will go down, but demand for their service will go up.
Panel: Limited resources are the current and future problem. Policies will have to motivate our behaviors. What if we totally redirect our resources away from simply buying expensive fire apparatus? This would be a new paradigm. We need to have discussions like we're having here, because we need to think beyond simply buying fire apparatus.
Panel: We are under-resourced today. If we had a more uniform approach to this problem, we could better address it.

Comment: We're having a real problem getting new volunteer fire fighters. The attraction today is not there. Really concerned that there is increasing demand, but we have less resource to address it.

Question: If we don't understand the status quo, how will we solve problems? We might think there is a problem, when society is telling it's not a problem. We should not resort to a scare tactic approach.
Panel: An example of this is the fire death rate, which has dropped dramatically.
Panel: Regarding fire death rates, yes we have been successful in reducing fatalities, but it is still unacceptable for our gross national expenditure.

Comment: Everything so far has focused on the barriers. We need to take credit for all our strong advances, which are significant.

Comment: Fire safety is not the only problem being addressed in elderly housing. Adding stairwells in senior housing actually address new other hazards.

Comment: We need to make people realize this (aging population) is a problem, but many people are in denial. They don't think it will happen to them. This is a systemic issue that needs to be dealt with. Technology with sprinklers and detection is still needed, but we need to address the systemic problem.

Comment: Even with our advances, how did we have the Station fire? Even after this fire, we still have to fight with owners to install sprinklers. It's not the mindset of people to install sprinklers.

Comment: Representing volunteer fire service. End result of everything we do is "to call the fire department". Need to remove the fire department from the equation as a reactive solution and utilize the technological advances that are being made.

6) SESSION TOPIC 2: MATERIALS AND TECHNOLOGY

"Technology is a way of organizing the universe so that man doesn't have to experience it."
Max Frisch
Swiss architect, playwright, novelist (1911 - 1981)

Session Two Keynote Presentation

The keynote presentation of the second topic area on "Materials and Technology" was presented by Dr. Philip Anton, Director, Acquisition and Technology Policy Center at the RAND Corporation. Dr. Anton provided a sweeping overview of changing materials and technology and their relationship to fire safety today and in the future.

Dr. Anton began his address by stressing the importance of global technology and its implications. There will be significant challenges with new technology, such as the new hazards it creates (e.g. health or environmental hazards), as well as privacy and ethical concerns. Several examples of technological advances were offered that are expected to increase in importance, such as information availability and utility, biotechnology, smart materials, nanotechnologies, and other innovative technological applications. More specifically, these examples might include biotechnology trends (e.g. personalized medicine based on databases of patient data), and nanotechnology trends (e.g. new families of chemical and biological sensors, improvements in battery capacity, wearable personal medical monitoring devices, capability of widespread human and environmental monitoring, etc).

The needs of the fire service have parallels to the needs of the military, and Dr. Anton explained this similarity in detail by referring to earlier studies, including one study for the National Intelligence Council that addressed the top 16 leading candidates for globally significant technology applications. Some of these 16 candidate applications relate directly to the fire service, for example:

- PPE (personal protective equipment) related applications would address a range of hazards and human factors. Trends include better integration with today's technology, continued advances in active and smart materials, and integrated advanced radios.
- Nano-enabled PPE Biodefense Systems, relying on integrated multifunctional components in the materials, are long term applications which would address time frame, system type and function.
- Command, control, and communications (referred to as C3) applications address issues such as incident control. Trends include internet and private networks, search algorithms, decision support systems, dispatch, planning, multi-agency cooperation, communications, and reliance on reliable internet technology.

- Situational awareness and search strategies include assessing a particular situation, and establishing and sharing a common operating picture (COP). Trends include expanded new sensing capabilities, reduced cost and size of sensors, networks, mobile tracking, tracking responders, automated integration and display, and expanded integration condition sensors.
- Other challenges and needs include air and water transport, functioning in extreme or remote conditions, human performance limitations, and logistics applications.

Dr. Anton indicated that there are different drivers and barriers that influence technology development and capabilities. It is one thing to have a new worthwhile invention, and it is another to bring it to the marketplace and get it widely implemented. For example, we have established the technology for hydrogen cars, but we don't yet have infrastructure to support them. Technical feasibility can be tracked with implementation to highlight development conditions.

As technology provides new capabilities in the next 25 years, the first responder community needs to continue to monitor their application to other fields such as the military, so as to leverage these investments. Broad government and industry investments are posed to address multiple subject areas, such as materials, nanotechnology, biotechnologies, sensors, robotics, etc. Technological advances and trends that we are expecting include:

- Mobility relevant for air and ground transport, including rough terrain mobile units derived from military applications.
- Ability to function in extreme and remote conditions using on-the-ground robotics, performing tasks such as tele-medicine applications using robotic surgery.
- Better fire protection and automated responses include fire resistant buildings and automated vehicle shutdown.
- Human behavior issues such as human performance extension, logistics, on-demand training, and control of volunteers.

In summary, Dr. Anton focused on information availability and utility, biotechnology, smart materials, and nanotechnologies as areas where big technological leaps are expected. The subsequent panel discussion provided feedback where the panelists agreed that with these new developments come new concerns for society at large which will also affect fire protection. Examples include privacy and ethics concerns related to information access and unknown fire and health hazards associated with new materials. However, these new technologies also provide great promise for fire safety. Fire fighting will benefit from robotics, decisions support and communications technologies, and advanced sensors. The ability to "design" materials and fire protection systems will lead to hazard mitigation and more efficient use of fire protection resources.

Session Two Keynote Speaker Question and Answer Dialogue

Question: Clarify the remarks on quantum computing.
Dr. Anton: This is based on a 15 year perspective. It's hard to imagine what we actually going to do with this application.

Question: What does privacy mean to a baby boomer, and are there generational differences? This will likely be a looming question for the future.
Dr. Anton: This topic certainly has cultural implications, as evidenced by the reactions to changing cultures already expressed at this conference. This is generationally dependent as well as culturally dependent.

Question: The C3 model mentioned earlier is for command, control, and communications, and a suggestion for a fourth C would be clinical. We need baseline physiological data for field applications, and we need to catch up on the basics. We can measure the heart rate, but we're not sure what to compare it to.
Dr. Anton: This is a good point. Even the military is not doing this very well at this time, and this needs to be better addressed.

Comment: A wide range of new technologies are under development in certain arenas (e.g. fuel cells, hybrid cars, new materials), and these will certainly impact fire protection and safety as we start the next 25 years.

Session Two Panel

After the presentation by Dr. Anton, the panelists for conference session two addressed the second primary topic area on "Materials and Technology". The panel was moderated by Greg Monty from Underwriters Laboratories, Inc., and the panelists were:

- Robert Boyer, GE Fire and Security (fire alarm industry perspective)
- John Dean, State of Maine (state fire marshals perspective)
- Russ Fleming, National Fire Sprinkler Association (fire protection engineers perspective)
- Anthony Hamins, National Institute of Standards and Technology (federal government research perspective)
- Bob Khan, Phoenix Fire Department (metropolitan fire chiefs perspective)
- Ian Stronach, Rio Tinto (building owner/operator perspective)

Each panelist provided a brief 10 minute overview of their perspective relating to the session two topic of materials and technology. The following provides a summary of the key points made by each presenter:

a) Robert Boyer, General Electric (the fire alarm industry perspective).

- For detection, we are looking at technology that would result in lower false alarms, provide better detection, improve efficiencies, and use multiple sensing technologies. Examples are detection technologies called "trace" and VID (video) systems.
- For signaling, we are looking at low voltage systems, intelligibility, and approaches that use directional sound.
- For systems applications, consideration is being given to the development of specific personalities for a specific application. This would provide features that include more comprehensive tenability information for fire responders, and could map the progression of the event for the incident commander.

b) John Dean, NASFM (a state fire marshal's perspective).
- We are interested in incident command utilizing new software approaches, and resolving short term issues involving the current struggle with different radio frequency problems.
- New smoke detector technology advances were made in the past 25 years, and now additional smoke detector technology shows promise, though advances will be needed to maintain the public confidence in smoke detectors.
- We need to continue promoting residential sprinklers, since homes are a significant part of our fire problem and these are occupancies were the enforcement community has much less control.
- Maintenance of these systems using both old and new technologies is important, as we do not want massive recalls that will cripple public faith.
- We need to face certain public policy issues. An example is the NASFM policy on fire retardant chemicals and nanotechnology. Fire retardants are important for consumer fire safety, but they should be balanced with their overall harm to health or the environment, which is important not only to the public but also to the fire service in situations such as respiratory exposure risk during overhaul.
- Green buildings are introducing new and different challenges to fire fighting operations that need to be better addressed.

c) Russ Fleming, NFSA (a fire protection engineer's perspective).
- Automatic sprinkler system protection has had significant advances in recent decades, and going forward it is being looked at as a relatively stable and mature science, and provides a strong baseline for our expected high levels of reliability in the fire protection community.
- We recognize the growing use of water mist systems, but this is actually an old technology that is now simply becoming more mainstream.
- An important trend is toward more specialized products and more specialized systems for specific applications and niche markets. This will require involvement from the research community for customized protection schemes to provide a verified level of confidence.
- Environmental issues are on the horizon and are a concern for water based systems, and future changes could occur, such as ways to capture water in sprinkler testing.

Meanwhile, from an overall standpoint, automatic sprinkler systems are looked upon as being an important tool in the effort to have a sustainable and controlled environment.

d) Anthony Hamins, NIST (a federal government research perspective).

- Future needs should relate and be connected with the applied science of today, and remain tied to solving real world problems. For example, we need to address specific challenging questions for events like the recent Charleston, SC fire where 9 fire fighters perished.
- Technology for the fire service is already advancing at a great rate. We need to continue to stimulate this advancement, and promote fire service improvements such as integrated sensors and controls and locator systems that will greatly help fire fighters. For example:
  - Fire fighters of the future will be different from today and their transition is already happening, with new advances creating an information rich environment on the fire ground.
  - The use of robotics is advancing, especially in certain countries like Japan, and this work needs to continue.
- The current advancement of technology development for applications in the built environment needs to continue, with important topics being addressed like nanotechnologies. Examples of other details that need to be considered include:
  - Computer modeling of fire has been significantly advanced in recent years, and the further development of these models needs to continue. These computational models are a yardstick for the current state of the science, and they have strong promise for applications with design and investigation applications, and long term with reducing the need for full scale fire testing.
  - All risks associated with these technological advances need to be considered, not only their fire safety potential but also their risk to health and the environment, such as the current debate on banning certain types of fire retardants.
- Numerous factors are indicative of the trends in how the fire problem will change in the next 25 years, and many have already been mentioned like a growing elderly population and congested urban areas.

e) Bob Khan, Phoenix Fire Department (a metropolitan fire chief's perspective).

- The fire service has specific needs that need to be addressed today and into the future. Fire fighting will continue to be a challenging and dangerous profession requiring the support of new technology.
- New hazards are appearing to fire fighters with new building techniques, and the needs of the fire service have to be addressed with the development of these new building techniques. Examples include:
  - New roofing construction techniques are introducing new hazards during fire fighting operations.
  - The dangers of collapse with light weight wood truss construction that has resulted in fire fighter casualties in certain jurisdictions, and is now being studied and addressed.

- New hazards are appearing with other new technologies and applications, such as with energy efficient buildings. Another specific example is a new bio-diesel type heating unit that is now being found in certain residential applications.

f) Ian Stronach, Rio Tinto Alcan (a building owner/operator perspective).
   - New technologies combined with the global economy are affecting fire safety decision making.
   - Global industry needs to obtain a clearer perspective on their fire safety goals as they head into the future. Current observations of their direction include:
     - Much of what is done in industry today is not required by code, and is voluntary. This will suffer as financial managers cut corners. Those not knowledgeable in fire safety are making unwise decisions, and these decisions are being made in unrealistic time frames.
     - In today's industrial environment there is pressure to provide deliverables. Industry is continually under immense pressure to reduce costs, and this is introducing new hazards.
     - In the past, full life cycle costs were used to calculate cost effectiveness, but this is not so in today's business world, which is focused more on flat construction costs. Today, there is a strong push to reduce manpower required, and at the same time increase productivity.
     - Industry generally has excellent fire loss data, but they need a way to enter this into a fire risk model for use by non-fire safety managers. Today, industry has a void and needs help educating managers with financial modeling tools.
   - Today we are exporting industrial manufacturing to other parts of the world, and this is creating new challenges for fire safety. Plants of the future will be designed and built off-shore, like an oil rig, and will result in lower construction quality. Engineering design flaws will likely result. Fire risk assessment will likely be done by less trained people.
   - Looking into the future, the trends for fire safety in industry might expect the following challenges:
     - New and unproven methods will be implemented with insufficient testing and approval.
     - Industry will grow and likewise the number of industrial fires will increase.
     - The consequence of fire losses will increase with the proliferation of mega facilities.
     - Maintenance will likely suffer with less manpower.

Session Two Panel Question and Answer Dialogue

Question: Does a typical global industrial company have standardized rules through all the countries they operate in?

Panel: Yes, at least in this specific example, they do apply the same rules and approaches across all installation, regardless of location or country.

Question: There is a strong political push to have ethanol additives now in gasoline. What are first responders doing with foam?
Panel: This is and isn't being adequately addressed. Update on the use of foam throughout the fire service is a challenge, and additional education and information is needed on this topic.
Panel: This is a good example of an issue that is particularly challenging for implementing in smaller communities.

Question: This is a two-part question. First, how is radio performance being addressed by the military? Second, how effective is RF identification in military applications?
Panel: Technology is being advanced on the use of mesh networks, which would be one basic advancement. This would allow grouping to be done on the fly.
Panel: This has been a challenge with trunk radio systems, and so far it has not been used in the hot zone. This is still being worked on. At this time the plan is to first implement this with EMS, before use in a hot zone. On surface streets, police have had success, and we will know more on this by the summer of 2009.

Question: What will be the acceptance of off-shore technology?
Panel: We now live in a global economy. In the U.S. we have an open market with third party certification.
Panel: Looking at all off-shore products if they meet the same performance levels.

Question: Europe applies a cautionary principle based on the fire service needing to assure a uniform level of quality. What is the fire service position on this approach?
Panel: The U.S. fire service is now working interactively with manufacturers to solve a range of problems. An example would be the situation involving fire retardants.

Question: An ideal fire control system would be able to properly identify the fire, activate a fire suppression system, and then turn itself off. Technologically, how far are we from having something like this?
Panel: This could be done today, but it would have to be specialized. Sensors need to be further developed for this application.
Panel: Simple technology has already been used with automatic sprinklers, including the old on/off sprinklers. These have disappeared, due to clogging and other technological issues, and this has not returned because the need for them has not been there to date.

Comment: We need more involvement from the fire service and professional fire fighters in establishing the parameters for system performance.

Question: How are reliability and maintainability being addressed for new system technology?
Panel: Systems are getting there as well as products, but they have a way to go.
Panel: Systems can address this, but we also have other concerns. Other problems might occur, such as a design alteration to the building that might change system performance. We still need design verification.

Panel: From the owner's perspective, there is also a concern with replacing in-house expertise with outside consultants, which implies quality control.

Question: What is the most pressing cost benefit issue for residential sprinklers?
Panel: The best review of this was arguably the Scottsdale study, but there have been others. Recent changes to the International Residential Code are very significant. The trend has been to adopt sprinkler ordinances even without cost benefit studies.
Panel: As an example, the state of Maine already has 60 communities with a residential sprinkler system installed in one or more homes. It is proliferating, and developers are using it as a building trade-off. Cost benefit was addressed in detail at the International Residential Code hearings.

Comment: In addition, the American Public Health Association (APHA) wants to see residential sprinklers on the widest possible scale.

Question: There has been a lot of debate on the use of stairs for monitoring people movement. To what extent can we use VID (video) systems to also address people movement issues? What are compatibility issues?
Panel: VID systems show strong promise, and will likely be adapted as we head into the future.

Question: How do we get better incident data, for frequency and severity? A specific example is laptop battery fires.
Panel: Data collection is a continuing challenge due to litigation, off shore manufacturers, and widespread incidents across the broad consumer market.

Comment: NFPA and FPRF can provide a focus on collecting and sharing available information.

Question: A lot of us have the necessary engineering tools, but were lacking data. What are the metrics to evaluate new products, such as wood truss roofs? We need better data, and better metrics.
Panel: One particular global company has close to 30,000 incidents in their internal system. They have worked interactively with their protected risks, and they cooperate together. They compare this data with public domain data. Many incidents never involve the public fire department, and thus it never appears in their respective loss summaries. Likewise, insurers are only seeing the extreme events.
Panel: For data collection, fire service personnel have traditionally not been good at providing written documentation.

Comment: The challenges of data collection are true on a local level and on a state level. For fire service documentation, we need data collection venues that turn this information around more quickly for fire service use, with friendlier user input such as with a dashboard entry system. An interactive fire data loss summary would be particularly helpful.

Comment: These are good points about lack of data. However, we did build nuclear power plants and we did land people on the moon. We can do it without data.

Comment: Any time an alarm goes off, we need to capture it. Any time anything happens, we have to be better at capturing it, possibly through approaches like the proposed new Google smart grid.

7) SESSION TOPIC 3: ENVIRONMENT, ENERGY, AND SUSTAINABILITY

"Adapt or perish, now as ever, is nature's inexorable imperative."
H. G. Wells
English science fiction novelist (1866 - 1946)

Session Three Keynote Presentation

The keynote presentation of the third topic area on the "Environment, Energy, and Sustainability" was presented by Ms. Shere Abbott, Director of the Center for Science and Practice of Sustainability at the University of Texas at Austin. Her presentation clarified important trends related to the environment, energy use, and sustainability, and she challenged participants with the threats to achieving a sustainable global environment in the future.

Ms. Abbott opened her presentation with clear indication of her main messages: sustainability is not simply or solely an environmental issue; climate change is looming large; the future environment is uncertain and unknowable; and all sectors of society will be impacted and must adapt.

She presented the following concerns related to relationship between human development and the environment:

- Trends in human development forecast consumption are greatly expanding; no ecosystem on earth will remain untouched by mankind.
- Ecosystems are going through extensive changes throughout the world, but instead need to be sustained. Some losses that have already occurred have been irreversible.
- Degradation of the ecosystem is causing greater overall harm to humans then the value of the converted land.

Ms. Abbot then described the disruption of weather patterns and major changes in local microclimates as features of climate change. She presented data illustrating the spatially uneven increase in earth temperatures and corresponding precipitation patterns along with projections for an accelerating increase in these trends. She presented examples of current global harm, with flooding in certain areas, loss of the Amazon rain forest, and perhaps the most relevant example, hotter temperatures and more serious wildfires in the western United States.

The economic consequences of sustainable development in the developing world mean that efforts to bring about change will be challenging.

Society's options to deal with this include the following three approaches: 1) mitigation, 2) adaptation, or 3) suffering the adverse impacts. Currently we are doing all three. Each has their pros and cons, and there is no magic bullet solution. If there is to be a transition to a sustainable environment, nature and science will need to work together. This is a huge challenge, and will depend on political will and many other factors.

What does this mean for the fire service and the fire protection community? We can expect an increase in the cost of fire fighting. Land management policies need to be addressed since an increase of burn areas is expected. Specific issues to consider include:

- Water conservation will impact fire fighting and built-in fire protection measures
- Drought will result in more wildland fires.
- Urbanization patterns need to be monitored. We have now crossed the threshold where more than half the world population is now living in cities, creating great challenges but also great opportunities for fire safety.
- Green building concepts need to continue to be supported, and the tradeoffs between green concepts and safety need to be balanced.
- The changes in public attitudes need to be addressed, for both safety and the environment.

In summary, Ms. Abbott indicated that our challenge is to live sustainably on this planet. To achieve this goal there needs to be huge political will for sustainable development. This is in part a scientific problem, in part a political problem, and in part a public attitude problem. Strategies must be implemented to reduce the impact of mankind on the environment to move toward a sustainable ecosystem.

Session Three Keynote Speaker Question and Answer Dialogue

Question: People seem to need a crisis for change. Are we there yet on this topic? What do we need for a policy change to start happening?

Shere Abbott: Change is starting to happening, but more is needed. The scientific community has not been forthcoming in describing this problem. They need to inform policy, and not make it. The scientific community has done a very poor job educating the public. Further, just showing the water level rise in Bangladesh is not enough, we also need to inform the public how many people will die when the water rises. The environment needs to be higher on our list of priorities.

Question: We have a great microcosm of this debate in our professional community, and the fire protection community has contributed greatly to alternatives to halons (which harm the stratospheric ozone layer), including the development of new hydrocarbons and inert gases. The United States is currently supportive of alternatives based on HFCs because of cost, but what are the metrics to measure the impact?

Shere Abbott: This is an excellent question. Everybody is looking for these metrics, but they're not here yet. We need to integrate the long term issues into the economic framework that

currently only looks forward to the next couple of years. We need to measure this against the current damage to the Earth's ecosystems.

Question: Currently we are in an economic crisis. Is this good training for what we will see in the future?
Shere Abbott: Yes, we need to become more efficient, and the economy will have to adjust.

Question: How unique is your university compared to around the world?
Shere Abbott: The academy has created this board, and each participant has now gone back to their own universities and started certain activities. What has happened at University of Texas and is happening at other institutions (e.g. in Italy and at Stanford). We are moving forward, but we're not moving fast enough.

Questions: The real challenge going forward will be competition for resources. Peaceful transitions are hoped for, but it is likely that their will be competition for these resources, like water, and this might not be peaceful. Has there been any discussion looking at mitigating strategies for possible conflict?
Shere Abbott: Yes, through the adaptation concept. This was less so in the beginning and more so now, since models are now clearly showing who is at risk and how. The problem is where is the money going to come from and how? Adaptation was beginning and then the events of 11/Sept/2001 happened, and there was a complete re-alignment. Embracing the policy maker's attention is very challenging, and it's extremely difficult to tell this to the developing world. For them, what's more important, poverty or environmental protection?

Comment: On the ISO committee TC92/SC3 (Fire Threat to People and Environment), we currently have very poor US presence. We have a fire protection forum on sustainability, and it is being underutilized. We need better involvement and focus on this topic.

Session Three Panel

After the presentation by Ms. Abbott, the panelists for conference session three addressed the third primary topic area on "Environment, Energy, and Sustainability". The panel was moderated by Carl Baldassarra, Schirmer Engineering Corporation, and the panelists were:

- Ed Altizer, State of Virginia (state fire marshal's perspective)
- James Golinveaux, Tyco Fire and Building Products (water based suppression industry perspective)
- Jon Hall, FM Global (insurers perspective)
- Jim Pauley, Schneider Electric (codes and standards perspective)
- Bill Stewart, Toronto Fire Services (metropolitan fire chiefs perspective)
- Ian Thomas, Victoria University (academia perspective)

Each panelist provided a brief 10 minute overview of their perspective relating to the session three topic of environment, energy, and sustainability. The following provides a summary of the key points made by each presenter:

a) Ed Altizer, State of VA (a state fire marshal's perspective).
   - Green buildings and sustainability are an important new issue for the fire community to address.
   - New technology and new products for a sustainable environment are important to the fire enforcement community and for fire safety, and require additional attention.
   - Sometimes sustainable solutions have un-intended impacts. For example, the use of compact gravel surfaces rather than pavement might inhibit fire apparatus access to buildings.
   - Advancing residential sprinklers needs to continue. We have had great success in commercial buildings, and now we have to address residential. Sprinklers extend the life of buildings, and contribute to the spirit of green building concepts. We have not properly educated the public, and even the fire service, on the value of residential sprinklers.
   - We need to better promote interaction of environmental and energy conservation initiatives with plan review among enforcement officials.

b) James Gollinveaux, Tyco (a water based fire suppression industry perspective).
   - The fire protection community needs to more seriously and collectively face the sustainability question.
   - Declining water availability is becoming a concern, and we need to do more with less. It's becoming less okay to keep using large conservative safety factors. This might create bigger risk, but we need to be factoring in the damage to the environment and other factors, such as loss of business continuity.
   - New materials and new technology may ultimately create greater hazards; this trend is increasing and needs to be monitored.
   - Public attitudes need to change toward taking more individual responsibility for protection and safety. For example, homeowners need to better protect their own homes from wildland fires with new strategies.

c) Jon Hall, FM Global (an insurer's perspective).
   - Fire safety is an integral part of sustainability. This can be addressed by looking at the carbon footprint of the building over time. A green building may result in a greater initial carbon footprint, but it may be more sustainable.
   - The need for sustainability is having a significant impact on our future direction. Specific challenges and issues being considered include:
     - Supporting and working with the LEEDs program to help maintain fire safety, within the context of environmental sustainability.

- Addressing conservation of limited resources, such as those used in running fire pumps and testing hydrants, and minimizing the testing of this equipment through advanced monitoring.
- Recognizing that the greenest of all fire safety technologies is already here through automatic sprinkler systems. Fires in unsprinklered buildings create 36 times more damage than sprinklered building fires.
- The insurance perspective is to promote fire safety, and this is consistent with green building and sustainability. We are now looking at all literature to make sure that everything done is sensitive to the green movement, while preventing inappropriate loss. We are also exploring the fire implications of sustainable products.

d) Jim Pauley, Schneider Electric (codes and standards perspective).

- We need to better address the environmental hazards we don't know about before they are widely implemented, and find acceptable alternatives. Examples include:
  - Lead free solder. This makes a lot of sense from a health and environment standpoint, but it unfortunately creates a manufacturing problem. There is not an obvious alternative.
  - Flame retardant wire and cable. There are a lot of substitutes, but none of them are ideal.
  - Products using mercury. Energy efficiency is driving fluorescent lamps, which is promoting the use of mercury that has its own environmental issues.
  - Reducing traditional materials in wire is causing wire to become more brittle and thus more hazardous.
- Consider policy oriented programs like REACH. This is a movement out of Europe that is growing, and it stands for: Registration, Evaluation, Authorization and Restriction of Chemical substances.

e) Bill Stewart, Toronto Fire Service (a metropolitan fire chiefs perspective).

- We need to be more resilient to changes in the environment and better learn to adapt our fire fighting skills and strategies. We need to have mitigation and adaption strategies. The fire service needs to work with others on these important issues, even in small ways such as green tactics at fire stations.
- There will likely be more large scale type events, based on the rapid urbanization that is expected.
- We need to support strategic initiatives, like promoting the use of residential sprinklers.
- Fire fighting implications with new technology in the built environment is an issue. We want to use robotics and other technologies, and better equipment. For example, we need better foams, and other tools that will be effective and at the same time reduce environmental risk.

f) Ian Thomas, Victoria University (an academia perspective).

- Sustainability means different things to different people. For example, people in New Guinea face sustainability issues unrelated to external human intervention.

- What does sustainability mean for fire protection and fire safety? There are many other threats in our world, and some other than fire safety are more significant.
- One of our main improvements in recent decades arguably is the addition of smoke detectors; it's unclear from Australian statistics whether built-in fire protection measures are really helping.
- We are working on the wrong problem; human behavior dominates fire safety.
- Overall risk analysis is needed. Risk can never be reduced to zero, but we need to lower it to acceptable levels. We need to approach it collectively. We need to address all our safety efforts collectively, and find the right balance. You're more likely to die or be injured from a fall, rather than in a fire. We need to stop reacting violently to trigger events and ignoring the long term. We need to be less reactionary and more focused toward the long term and the collective good. Sustainability is based on the long term.
- Cost is based on anticipation to fire, reaction to fire, and fire losses. These are all the summary costs of fire. We're probably spending too much. We are going to need to do more with less. The Fire Protection Research Foundation needs to help with this. We need to focus on collectively solving all our problems.

Session Three Panel Question and Answer Dialogue

Question: What is the future of fire fighting foams with new EPA restrictions? For example, with Navy applications we don't know what to do. This is a very difficult situation.
Panel: Fluorine free foams are a really difficult issue and an interesting challenge. Multiple teams are working on this. There is not a good solution to the problem at this time. We're concerned with health and environmental impact, but we still need these foams. There possibly may be a stop-gap measure coming out of Europe.

Comment: Appreciate Prof Thomas's comments. This is a human interaction and behavior issue. The number of fire injuries is only 1.8% of fall injuries. The fire department commonly responds to falls injury calls, and the code community needs to consider adding better stairs.

Question: Earlier panel comments mentioned our immense fire safety expenditure. Are we ready to look at a risk based approach and to cut out unnecessary expenditures? Is there a better way to make expenditures? Should we have a better risk approach? Do we need better measurement tools?
Panel: We can do better than were doing. All communities have limited resources, and we need to be wiser with these expenditures.
Panel: We need to do better with fire safety education, and better inform everyone on all the risks, not just on fire.
Panel: Strongly believe that risk assessment will ultimately be an important tool to help us to be more efficient.
Panel: With restricted substances, and when politics gets involved, rational decisions sometimes go out the window. We've seen this with banning certain substances like

cadmium. We spend tremendous amounts of money eliminating cadmium, but maybe it would be better to treat it as a controlled substance.
Panel: These issues come up in the code hearings where "redundancy" is argued both ways. We need better statistics on losses. Also, we need to better develop and better improve our models.

Question: The National Electrical Code has changed to mandate AFCIs (Arc Fault Circuit Interrupters). Do you think that older homes would benefit from these, and how do we educate the public on the value of these devices? Also we are putting microprocessors everywhere in homes, and where is this all going?
Panel: AFCIs are not a recent development, but started in 1993. What we see in residential occupancies is a slow transition, and there will need to be recognition of incentives or benefits. We don't want a fire to ever start, and this is certainly a green type of thought, so I guess that means AFCIS are green. With respect to microprocessors in the home, today's blackberry's have more processing power than Apollo 11. There are a whole new set of challenges to electrical systems. Products need to be more resilient. Another example of green technology impact is solar power interaction on the primary power supply.

Question: I was astounded by Professor Thomas's remarks, and this is a big challenge for all of us. I understood this to mean that bad habits and human behavior are the bigger problems, and the use of built-in fire protection measures is not effective.
Panel: We need to think carefully about what we are doing. In Australia, for example, we see other changes having a large impact on fire safety, such as switching from incandescent lamps to fluorescent lamps. Other examples include change away from using grease in cooking and using electrical fuses. All these improvements have reduced home fires. It's hard to measure their overall impact in the context of smoke alarm use. In the U.S., however, smoke alarms have been shown to be statistically valuable. One reason might possibly be the type of construction, like multi story use in the U.S. but not in Australia. The important fact is that there are statistics to understand all this, and they're not being properly gathered and used.
Panel: The insurance industry is based on loss statistics. These losses are carefully measured. We have always had a focus on prevention, rather than intervention, and always lead with prevention.

Question: Following Professor Thomas's comments, much of this can be linked to cultural differences between countries. For example, in Germany the rules must be applied, and you don't have the behind-the-scenes fighting in the design process. People in the U.S. don't think fire is important, and don't take as much responsibility for their actions. In the U.S., people need to be better educated.
Panel: When we speak about cultural differences, most important is the litigious nature of our society. In the U.S., we feel we should have 100% protection built into our products. In Europe, they don't have this concern, and much of that built-in protection is voluntarily done.

8) POST-CONFERENCE THOUGHTS

"The best way to predict the future is to invent it."
Alan Kay
American computer scientist (1940 -)

After the conference follow-up input was solicited from the participants. That input is captured and shared here. Attendees were asked if any major issues were missed or overlooked. Further, they were asked if there are one or more key areas that, from their perspective, the Fire Protection Research Foundation should focus its efforts. Is there an area that the Fire Protection Research Foundation should assume leadership in? Are there topics or specific areas that the Foundation should look for collaborative partners?

The following are the comments that were received after the conference, edited for consistency:

Follow-up Comment 1
The conference touched on a number of important issues affecting society and our profession, and also the "blend" was about right. There were a few topics, however, that might also have been addressed, which are potentially important to make a difference in the next 25 years:

a) We have made great strides with technology and the integration of technology into new buildings through the adoption of building codes and standards. A major challenge for the profession is, "What do we do with the existing buildings to improve fire safety?" Clearly, the work of the FPRF in the area of electrical systems in older buildings is important and we look forward to the recommendations from it. But, there is more needed to address that threat, otherwise we will see a plateau of fire fatalities until such time as the older building stock is replaced over the next 50 to 75 years.

b) We spend considerable time debating the "necessary" level of fire safety, often without adequate data. The fire loss data we gather as a country is clearly inadequate to assess the probable impact of various fire protection strategies. We frequently do not know the "real" impact of various protection features in buildings which have undergone a fire event because we do not accurately know the features in the building, and we do not receive an analysis of those factors in the typical fire loss reports prepared by the fire service. In fact, we do not even know the real "success" rate of automatic sprinklers since NFPA stopped keeping detailed statistics after about 1970.

The fire protection community could benefit greatly from a statistically sound sampling of fire losses across the United States which would identify the building features and factors

contributing to fire growth, fire spread, injuries and fatalities -- and the probable "real" effectiveness of automatic sprinkler protection in various occupancies.

c) Similar to the above, the profession would benefit greatly from a "black box" methodology of evaluating the impact on fire losses that various fire protection features would provide if added to a building. This, essentially, is a risk-based analytical method using the "systems concepts" developed by Nelson in the 1970s. This measurement system would greatly aid the debate about what and how much fire protection is truly necessary for providing a reasonable level of safety in various buildings. We in the profession could then better debate where society should spend FP dollars.

Follow-up Comment 2

The conference seemed to be a perfect balance of demographics, sustainability trends, and the fire protection needs and challenges that will be the focus of the US based fire protection community in the future.

Potential areas that were not of great focus during the conference were global demographics (both within the fire protection community and differing regulations, cultures and populations around the world) and the potential leadership and teaming efforts the FPRF could pursue moving forward on a global basis.

In addition, it was noted that there is no known database of information as it relates to emerging technologies (understandable in our capitalistic society) and what I would consider fire protection 'near misses' (e.g., a fixed fire protection system providing adequate protection; but, the event goes unreported due to minor economic impact on the parties involved). Inadequacies in fire protection are almost always well publicized and successes, while typically reported, are somewhat less well publicized. The challenge with a database of this type in our society would be visibility, anonymity, and the potential for follow-up. Granted, I do not have a solution in this regard; but, offer the following link as a potential model as developed for fire fighters: http://www.firefighternearmiss.com/.

Follow-up Comment 3

The collection of better data was mentioned several times at the conference. In recent decades we have been collecting data using the methods that are adequate, but can be improved. For example, conventional surveys are still sent circulated on a periodic basis, but why are we not instead using an on-going controlled wiki-type web-based approach, that could be interactive and would allow a much broader information collection effort. We need to re-think how we capture our data. This has already started showing success with “firefighternearmiss.com”.

Follow-up Comment 4

The program was very thought provoking and pointed us all in a different direction which is the correct approach for research. You have captured the key points that came out of the event and there is not a lot more one can add to it. The interesting point is how you can get some of

the large organizations to participate in key research areas that can bring a benefit to all involved in life safety, property and environmental protection.

Follow-up Comment 5

I wanted to share a few thoughts regarding trends for the next 25 years, which we discussed only implicitly if at all at the conference. Those thoughts relate to business trends. Two main themes of the recent past may or may not continue in the future…I would bet they do. These are *globalization* and *consolidation*.

First, *globalization* is an overused buzz word, but the reality is that business and the development and flow of capital are so interdependent across national borders that we have to try to understand what that could mean for fire safety. Products, services and standards are all influenced by globalization. For the moment, let's forget the geopolitical side and strictly look at the "creation of wealth" issues associated with development. The needs to develop infrastructure (energy, communications, transportation, housing, industry) are far greater outside the United States. So our economic well being will depend on our ability to assist the developing world. That's going to take more than software and video games.

Specifically related to standards, the days of using United States standards as a barrier of entry to foreign made products is long gone. Now more than in the past, the standards really reflect the common need for product safety…no melamine in the baby formula, or even the cat food. But the international fire safety standards, building codes, etc still present challenges. How NFPA standards are applied globally could influence the research needs.

We can't ignore the political uncertainties in the United States as it related to globalization. The United States does little manufacturing compared to previous decades. Will that trend continue or be reversed by rising third world labor cost, transportation costs, "national security" or other reasons. Just how the government reacts to our current global economic crisis will also have a potential impact on how fire safety is accomplished in the United States. The United States government taking equity positions in United States corporations could radically change the landscape regarding voluntary standards vs. federal regulations.

We could go on regarding subjects like education (specifically engineering education) and certification (SFPE Membership and Chapter growth is far greater in Asia than in North America).

The second topic is *consolidation*. The electric generating industry has been in a consolidation mode with fewer and fewer investor owned utilities (that has had a dramatic impact on EPRI membership.) Probably one of the trends impacting the way industrial fire safety is implemented in the United States is the radical change in the property insurance industry (this was also a large source of fire protection engineering training that has all but dried up.)

Our fire detection industry has seen the same. The allusion that bigger is better, or more accurately, economies of scale make for good business is a trend that may continue. If it does

continue, will our manufacturing partners be more or less willing to collaborate on research? One trend I believe that will be reinforced (if not exacerbated) by the economic down turn is that large companies tend to be less innovative than smaller less risk adverse companies. Research & Development budgets usually see more than a proportionate cut in funds in lean times. There will be far less Research & Development. I hope the opportunities for collaboration will be enhanced by these trends, but I am only slightly optimistic.

Follow-up Comment 6

Here are several additional thoughts related to sustainability. I was a little disappointed that there was not a lot of discussion related to improvements or research into basic materials. I think we fall into the trap that sustainable means either more combustible or totally inorganic/mineral based. There have been major improvements in basic materials that really are geared at sustainability. Also keep in mind that the materials available today may not do the job in the future.

Another thought on sustainability is it seemed that most of the attention was focused on suppression systems. The other side of the triangle deals with delaying ignition yet there was little mention of that. We often fall into the trap of saying that a sustainable building will always be a compromise with fire/life safety. For example, a particular headquarters' building for one of the panelists is a Platinum LEED building, and I can say there was no compromise in either fire safety or life safety.

Follow-up Comment 7

Consider this as a grand challenge for the Research Foundation: to promote an approach to require tools for all NFPA code changes to be accompanied by a documented cost benefit analysis.

Follow-up Comment 8

As a follow-up to the statistical references and cost comparisons mentioned during the first panel discussion, here are some additional numbers that deserve attention:

- The $294 billion cost of fire per year is 42% of the cost for the recently proposed $700 billion economic bailout package.
- The $294 billion cost of fire per year is $24.5 billion a month which is a little more than twice the estimated $10-12 billion monthly cost of the war in Iraq.

Follow-up Comment 9

FPRF could consider supporting certain SFPE activities with research on issues such as effective messaging, strategies to education the future FPE, etc. The actual implementation would be up to SFPE.

For example, the National Academy of Engineering has prepared a report on messaging to recruit high school students into engineering. With that as background, what message should SFPE use to recruit people into fire protection engineering? Yes, SFPE has done work in this

area but has the work to date been supported with research? The FPRF could provide that research to the fire protection engineering community.

With respect to education, there are a lot of models to be considered. Can research be performed to provide the SFPE leadership with information that would result in more effective implementation strategies by SFPE? For example, starting new FPE programs in today's environment may not be the "best" approach, and research is needed to confirm the most appropriate direction.

9) SUMMARY/CLOSING THOUGHTS

"Never let the future disturb you. You will meet it, if you have to, with the same weapons of reason which today arm you against the present."

Marcus Aurelius Antonius Augustus

Roman Emperor (121 A.D. – 180 A.D.)

The next 25 years will bring many challenges to fire safety in the built environment. Our changing demographics as a society, the new materials and technologies available to us, and the increasing focus on sustaining our natural resources, each will affect fire safety in multiple ways.

As the Foundation prepares for the future in celebration of its 25th anniversary, we have challenged the fire safety community to provide its perspectives on the key issues that will impact all of us. The Foundation will use this input to help shape our strategic research agenda for the future.

As part of this activity, the Foundation has convened a series of meetings to seek input from its NFPA constituency on this topic, culminating in this conference on "*Fire Protection and Safety: the Next 25 years*", held in Washington D.C. on November 17, 18, 2008. This White Paper captures this input and the perspectives shared by the leadership in the fire protection and safety community on the issues that will face them in the near future.

There are many different ways to interpret the multiple perspectives and rich information provided by all who have participated in this overall effort. The following summary captures the key issues identified that are likely to impact fire safety and NFPA codes and standards in the next 25 years.

Social and Demographic Change

What are the demographic, urban growth, human behavior and societal trends that will impact fire safety and NFPA codes and standards in the next 25 years?

Urban Growth Patterns:

1) The **wildland/urban interface** will continue to grow and will have an increasing elderly population. This will impact the design of communities (for example homes for the elderly) for conflagration type fire events as well as the design of evacuation routes and fire fighting tactics.
2) There will be increasing trend toward **higher density population** in urban areas, including a shift toward multi-family housing and public transportation modes. This will have impacts on the local fire safety infrastructure and emergency response demands.

3) Globally, the percentage of the population living in areas more subject to **natural disasters** (e.g. coastal areas, higher seismic areas) will grow. This will impact the design of structures for these types of events (e.g. special seismic requirements for fire safety systems) as well as the design of evacuation routes and fire fighting tactics.
4) Increased population density and consequent road congestion will result in **changes in transportation modes** to include an increased emphasis on public transportation. This will impact the occupancy levels and consequent egress design issues for vehicles and transportation terminals.

Demographic Changes:

5) As our population ages, the percentage of the **population with all types of disabilities will increase, as will the number of individuals living alone.** This will have a large impact on the design of buildings for egress; rescue techniques, increased demand for EMS, and emergency communication (in the form of multiple modes).
6) Changes in workforce demographics will dictate that the fire safety community must compete for a **declining qualified workforce**.

Cultural and Societal Attitudes:

7) Emergency preparedness for other forms of incidents including terrorism and natural disasters is now a major focus for emergency planning. There is a need to **integrate design for other types of emergencies** into fire safety design and vice versa. This has an impact on emergency planning, fire service resources, mass notification, protection of lifeline resources, etc.
8) As we become a more **safety oriented culture**, our regulatory structure will present conflicting environmental, workplace and fire safety objectives.
9) **Increased cultural diversity** in the United States will lead to new challenges for community based programs such as fire safety education, enforcement of fire safety regulations, and support of the volunteer fire service.

Changes in Materials and Technology

What changes can we foresee in materials and technology that will impact fire safety and NFPA codes and standards in the next 25 years?

New Materials:

10) The **changing furnishings** in today's buildings and building contents are creating changing and potentially for more challenging fire scenarios. This has an impact on fire fighter tactics, protective clothing and equipment, tenability conditions, and challenges some basic assumptions in the design of buildings for fire.
11) **Changes in storage configurations (contents, packaging, volume of storage)** in retail occupancies as well as storage warehouses are increasing the volume and hazard of stored commodities and creating high challenge scenarios.

12) Technological **advancements in built-in fire protection measures** are becoming commonplace, with new extinguishing media and methods, alternative approaches to emergency awareness, and '*smart*' materials presenting the opportunity for improved fire characteristics.

New Technology:

13) **Rapid developments in fire fighting and fire safety equipment** (such as robotics, sensors, communications technologies, and light weight equipment) provide promise for increased firefighter safety but require assessment of performance criteria and training and evaluation.
14) Application of **alternative energy sources** in technology, e.g. L.E.D. lighting or distributed electrical generating technologies, will require a reassessment of fire safety of our current electrical infrastructure.

Changes in Environment, Energy, and Sustainability

What changes can we foresee in our physical environment that will impact fire safety and NFPA codes and standards in the next 25 years?

Climate Change:

15) Climate change may be increasing the magnitude and frequency of certain large-scale natural and man-made disasters such as **wildland fires, wind events and floods**, which will demand changes in firefighting techniques and resources. The impact of these changes will be magnified by related shifts in urban growth to areas at risk.
16) The concern regarding climate change is generating an associated interest in **green building design.** The fire safety impact of new types of wall construction, increased thermal tightness, solar and other alternative energy sources, etc, must be addressed.

Aging Infrastructure:

17) Our aging building infrastructure will result in an increased emphasis on **renovation and repurposing**, demanding performance based approaches to fire safety design and an understanding of the fire safety impacts of repair/retrofit technologies. For example, aging home electrical systems will require new approaches to inspection and/or retrofit technologies.
18) The performance of aging fire and electrical safety systems has not been evaluated in many cases and there will be an increased **need for inspection and maintenance** as part of an overall fire safety strategy.

Declining Energy and Other Natural Resources:

19) The increased use of **alternative vehicle fuels** in new applications will have a major impact on fire safety in all occupancies. Biodiesels, ethanol/alcohol, hydrogen, and electric hybrids all present different hazards and will demand: unique emergency

response/fire fighting tactics; suppression agents; and an assessment of the impact on the existing electrical infrastructure.

20) **Declining water resources** are having a major impact on fire suppression systems and fire fighting strategies. This impacts available community resources for residential fire fighting and home fire sprinkler design requirements, water pressure requirements for high rise and other high water volume fire control strategies.

Environmental Sustainability:

21) **Environmental restrictions on chemicals** are already impacting the selection of fire suppressants, hazard control of building contents and furnishings, and fire fighting tactics.

10) NEXT STEPS

"Wir müssen wissen, wir werden wissen - We must know, we shall know"
David Hilbert
German Mathematician (1862-1943)

This conference, and the dialogue and information-processing efforts that occurred prior to the conference, represent a turning point in the Foundation's 25 year history. As we prepare for our next generation of research programs, the input and direction contained herein will have an impact on where we head in the future.

Where do we go from here? This white paper report is scheduled to be released at the end of 2008. In early 2009, it will be reviewed and discussed by the Fire Protection Research Foundation's Board of Trustees as a roadmap for the Foundation's strategic research agenda. The Foundation is committed to maintaining an ongoing dialogue with NFPA Technical Committees and others to ensure that the challenges facing fire safety are reflected in NFPA codes and standards development.

The next 25 years will certainly include change, and, based on the accelerating factors influencing demographics, urban growth patterns, material and technological development, environment, energy and sustainability; it is likely that this change will be significant. The fire protection and safety community will need to adapt and keep pace with this change. By doing so, we will be able to readily address the challenges of tomorrow.

ANNEX A: CONFERENCE PARTICIPANTS AND ATTENDEES

The following were the Conference Special Topic Speakers:

- James M. Shannon, President, National Fire Protection Association and Chairman, Fire Protection Research Foundation Board of Trustees
- Craig Beyler, Ph.D., Hughes Associates, Inc. and Chairman, International Association of Fire Safety Science
- Kathleen Almand, Executive Director, Fire Protection Research Foundation

The following were the Conference Keynote Speakers:

Session One: "Demographics and Urban Growth Patterns"

- Kevin McCarthy, Ph.D., Senior Social Scientist, RAND Corporation

Session Two: "Materials and Technology"

- Philip Anton, Ph.D., Director, Acquisition and Technology Policy Center, RAND Corporation

Session Three: "Environment, Energy, and Sustainability"

- Shere Abbott, Director, Center for Science and Practice of Sustainability, University of Texas at Austin

The following were the Conference Panelists:

Session One: "Demographics and Urban Growth Patterns"

- Fred Mowrer, University of Maryland (session one moderator)
- Stacy Welch, Marriott Corporation (building owner/operators perspective)
- Kathy Ann Notarianni, Worcester Polytechnic Institute (academia perspective)
- Ozzie Mirkhah, Las Vegas Fire and Rescue (fire officials perspective)
- William Koffel, Koffel Associates (fire protection engineers perspective)
- Paul Hough, Armstrong World Industries (building products industry perspective)
- Larry McKenna, U.S. Fire Administration (federal fire service perspective)

Session Two: "Materials and Technology"

- Greg Monty, Underwriters Laboratories, Inc (session two moderator)
- Robert Boyer, GE Fire and Security (fire alarm industry perspective)
- John Dean, State of Maine (state fire marshal's perspective)
- Russ Fleming, National Fire Sprinkler Association (fire protection engineers perspective)
- Anthony Hamins, National Institute of Standards and Technology (federal government research perspective)
- Bob Khan, Phoenix Fire Department (metropolitan fire chiefs perspective)
- Ian Stronach, Rio Tinto (building owner/operator perspective)

Session Three: "Environment, Energy, and Sustainability"

- Carl Baldassarra, Schirmer Engineering Corporation (session three moderator)
- Ed Altizer, State of Virginia (state fire marshal's perspective)

- James Golinveaux, Tyco Fire and Building Products (water based suppression industry perspective)
- Jon Hall, FM Global (insurers perspective)
- Jim Pauley, Schneider Electric (codes and standards perspective)
- Bill Stewart, Toronto Fire Services (metropolitan fire chiefs perspective)
- Ian Thomas, Victoria University(academia perspective)

The following were the Conference Attendees:

Shere Abbott	University of Texas
Kathleen Almand	Fire Protection Research Foundation
Ed Altizer	State of Virginia
Philip Anton	RAND Corporation
Stephanie Ayers	Evonik Foams
Carl Baldassarra	Schirmer Engineering Corp.
Bob Barker	Fire Fighting Enterprises
April Berkol	New York, NY
Craig Beyler	Hughes Associates, Inc.
Robert Bill	FM Global
Art Black	Carmel Fire Protection Associates
Tim Blackford	Chevron
Donald Bliss	NI2 Center for Infrastructure Expertise
J. Robert Boyer	GE Security
Thomas Brown	Rolf Jensen & Associates, Inc.
Rodney Bryant	National Institute of Standards & Technology
Shannon Cardwell	Pool Corporation
Lorraine Carli	NFPA
Thierry Carriere	United Technologies Research Center
Michael Cassidy	Holliston Fire Department
Shane Clary	Bay Alarm Company
Stephen Coleman	Navair
Ed Comeau	writer-tech.com
Gerry Connolly	Kidde-Fenwal
Paul Crossman	NFPA
John Dean	Maine State Fire Marshal
Phil DiNenno	Hughes Associates, Inc.
Laura Doyle	U.S. General Services Administration
Christian Dubay	NFPA
Kenneth Dungan	PLC Foundation
Gene Eckhart	National Electrical Manufacturers Association
Peter Elliott	Corrosion and Materials Consultancy, Inc.
Joshua Elvove	General Services Administration
Daniel Finnegan	Siemens-Fire
Paul Fitzgerald	Holliston, MA
Russell Fleming	National Fire Sprinkler Association

David Frable	U.S. General Services Administration
Bruce Fraser	Fraser Fire Protection Services
Ladson Fraser	Precision Fabrics Group, Inc.
Richard Gallagher	Zurich Services Corp.
Richard Gann	National Institute of Standards & Technology
Thomas Gillmore	Tyco Fire Suppression and Building Products
James Golinveaux	Tyco Fire Suppression and Building Products
Casey Grant	Fire Protection Research Foundation
William Grosshandler	National Institute of Standards & Technology
Jonathan Hall	FM Global
Sam Hall	U.S. Department of Transportation
Amy Hamel	Center for Campus Fire Safety
Anthony Hamins	National Institute of Standards & Technology
Tom Hammerberg	Automatic Fire Alarm Association, Inc.
John Harrington	FM Global
Melissa Hebert	International Association of Fire Chiefs
Paul Hough	Armstrong World Industries, Inc.
Salvatore Izzo	The Reliable Automatic Sprinkler Co., Inc.
Thomas Jaeger	Jaeger & Associates, LLC
Robert James	Underwriters Laboratories Inc.
Marc Janssens	Southwest Research Institute
Sean Joyce	Worcester Polytechnic Institute
Moriel Kaplan	Schirmer Engineering Corp.
Will Kenlaw	SimplexGrinnell
Bob Khan	Phoenix Fire Department
Janet Knowles	American Fire Sprinkler Association
William Koffel	Koffel Associates, Inc.
Ed Krawlec	U.S. Consumer Product Safety Commission
Kevin Kuntz	ISO
Gregory Lanshe	Zurich Risk Engineering
Fred Leber	LRI
R. Kenneth Lee	PPG Industries, Inc.
Adrian Lloyd	Micropack Detection (Americas) Inc.
Carla Mattingly	Navair
Kevin McCarthy	RAND Corporation
Lawrence McKenna	U.S. Fire Administration
Nancy McNabb	NFPA
Jack McNamara	Bosch Security Systems
Thomas McNelis	Intertek ETL SEMKO
Rodney McPhee	Canadian Wood Council
Shivani Mehta	U.S. Consumer Product Safety Commission
Lyle Miller	Worcester Polytechnic Institute
Ozzie Mirkhah	Las Vegas Fire and Rescue
Greg Monty	Underwriters Laboratories Inc.

Wayne Moore	Hughes Associates, Inc.
Frederick Mowrer	University of Maryland
Bruce Mullen	NFPA
Louis Nash	US Coast Guard
Susie Nicol	Firehouse.com
Thomas Norton	Norel Service Company, Inc.
Kathy Notarianni	Worcester Polytechnic Institute
John O'Sullivan	Langley Berkshire, UK
George Ockuly	O'Fallon, MO
Isaac Papier	Honeywell Life Safety
Paul Patty	Underwriters Laboratories Inc.
Jim Pauley	Schneider Electric/Square D Company
Jake Pauls	Jake Pauls Consulting Services
Kevin Pekarek	US Coast Guard
Charles Penny	Wealth Capital Management, Inc.
Stephen Pessiki	Lehigh University
Eric Peterson	Fire Protection Research Foundation
Raymond Quenneville	FireFlex Systems Inc.
Al Ramirez	Underwriters Laboratories Inc.
Stephen Raynis	FDNY
Rodger Reiswig	SimplexGrinnell
Tom Schlesinger	Siemens-Fire
Lisa Scott	U.S. Consumer Product Safety Commission
James M. Shannon	NFPA
John Shea	Eaton Corp.
Ronald Sheinson	Naval Research Laboratory
Blake Shugarman.	Underwriters Laboratories Inc
Ellen Sogolow	DHS/FEMA/AFG
William Stewart	Toronto Fire Services
Ian Stronach	Rio Tinto
Karen Suhr	National Association of State Fire Marshals
Adam Thiel	Alexandria Fire Department
Ian Thomas	Victoria University
Elaine Thompson	Allied Tube & Conduit Corp.
Randolph Tucker	The RJA Group, Inc.
Victoria Valentine	National Fire Sprinkler Association
Diana Wamakima	National Association of State Fire Marshals
Michelle Warren	Navair
Jack Watts	Fire Safety Institute
Stacy Welch	Marriott Corporation

ANNEX B: STAFF INPUT ON ISSUES CONFRONTING NFPA TECHNICAL COMMITTEES

NFPA codes and standards are constantly evolving to meet the changing needs of the fire protection community, and the next 25 years will bring many challenges to fire safety in the built environment.

As part of the Foundation's activity to clarify these challenges, a brainstorming session was held with the NFPA codes and standards Staff Liaisons on 27 August 2008 at NFPA Headquarters. The staff was asked to consider the anticipated topics that will potentially impact NFPA codes and standards. To structure the session, the focused on the three broad topic areas of: (1) our changing demographics as a society, (2) the new materials and technologies available to us, and (3) the increasing focus on sustaining our natural resources.

This information is included herein to help clarify the genesis of the other information included in this White Paper Report. This is not intended to provide an exhaustive list nor a validated data set, but rather it reflects NFPA technical staff's perspective on trends in code issues facing NFPA Technical Committees today.

Social and Demographic Change

What are the demographic, urban growth, human behavior and societal trends that will impact fire safety?
What are some potential impacts for NFPA codes and standards?

Urban Growth Patterns:

- The **wildland/urban interface** will continue to grow and will have an increasing elderly population. This will impact the design of communities (for example homes for the elderly) for conflagration type fire events as well as the design of evacuation routes and fire fighting tactics.
- Globally, the percentage of the population working and living in **high rise buildings** will continue to grow. Existing NFPA standards for fire safety in high rise buildings are premised on North American fire safety infrastructure and cultural norms. Modified approaches to high rise fire safety may be required for global applications.
- Increased population density and consequent road congestion will result in **changes in transportation modes** to include an increased emphasis on public transportation. This will impact the occupancy levels and consequent egress design issues for vehicles and transportation terminals. The United States will see an increase in roadway tunnels and

thus a design and emergency response infrastructure will need to be created for this occupancy.

Demographic Changes:

- As our population ages, the percentage of the **population with all types of disabilities will increase**. This will have a large impact on the design of buildings for egress; rescue techniques, increased demand for EMS, and emergency communication (in the form of multiple modes).
- One of the current consequences of our affluence as a society is a trend towards **increase in body size**. If this continues, it will have a major impact on egress, and on fire fighting techniques and clothing and equipment.

Cultural and Societal Attitudes:

- Emergency preparedness for other forms of incidents including terrorism and natural disasters in now a major focus for emergency planning. There is a need to **integrate design for other types of emergencies** into fire safety design and vice versa. This has an impact on emergency planning, fire service resources, mass notification, protection of lifeline resources, etc.
- As a society we are increasingly **less risk tolerant** and there is a higher baseline safety assumption (rather than reliance on personal action) which is an environment amenable to litigation and regulation. Further, there is a trend toward **higher risk taking behavior** (particularly with youth) which may necessitate new fire ground tactics.
- There is a societal trend toward **collective sharing of the cost of personal behaviors and disabilities**. This may result in universal design/mainstreaming of provisions to accommodate a broader range of behaviors and disabilities in all structures.
- As a result of both increased population density and societal attitudes toward risk, there is an increase in the "**not in my backyard**" mentality which is impacting the need for protection, spatial separation, and emergency response procedures for the storage of hazardous materials.
- There is a broad **awareness of terrorism** related risks and consequent security concerns. This in some cases will have a negative impact on fire safety through such issues as egress.
- As we become a more **safety oriented culture**, our regulatory structure will present conflicting environmental, workplace and fire safety objectives.

Changes in Materials and Technology

What changes can we foresee in materials and technology that will impact fire safety and NFPA codes and standards?

New Materials:

- The **changing furnishings** in today's buildings are generally creating hotter, faster developing, and more toxic fires. This has an impact on fire fighter tactics, protective

clothing and equipment, tenability conditions, and challenges some basic assumptions in the design of buildings for fire.

- **Changes in building materials** are also challenging some of the basic assumptions about the role of structural elements in overall fire safety design. This also applies to other occupancies such as transportation vehicles.
- **New occupancies** such as data centers, high risk high volume storage, etc., are increasing the volume and hazard of stored commodities and creating high challenges for suppression systems.

New Technology:

- **Rapid developments in fire fighting and fire safety equipment** (such as robotics, sensors, mission specific devices, light weight equipment) provide promise for increased firefighter safety but require new training and evaluation systems.
- There is a general trend toward an emphasis on technology as opposed to labor for design solutions. The fire implications are a move toward **hardware based solutions** as opposed to inspection based solutions.

Changes in Environment, Energy, and Sustainability

What changes can we foresee in our physical environment that will impact fire safety and NFPA codes and standards?

Climate Change:

- Climate change is increasing the magnitude and frequency of **wildland fires** which will demand changes in firefighting techniques and resources.
- Climate change is generating an interest in **green building design** which currently has an unknown impact on fire safety in buildings. Design issues such as new types of wall construction, increased thermal tightness, solar and other alternative energy sources, organic roofs, etc, must be addressed.

Aging Infrastructure:

- Our aging building infrastructure will result in an increased emphasis on **renovation and repurposing**, demanding performance based approaches to fire safety design and an understanding of the fire safety impacts of repair/retrofit technologies.
- The performance of aging fire safety systems has not been evaluated in many cases and there will be an increased **need for inspection and maintenance** as part of an overall fire safety strategy.

Declining Energy Resources:

- The increased use of **alternative vehicle fuels** in new applications will have a major impact on fire safety in all occupancies. Biodiesels, ethanol/alcohol, hydrogen, and electric hybrids all present different hazards and will demand: unique emergency

response/fire fighting tactics; suppression agents; and compatible/switchable refueling equipment.

- Manufacture and shipment will change as the form of energy source changes. This will likely result in more local and smaller manufacturing facilities which require unique emergency response tactics as well as industrial plant design. **Distribution networks and shipping patterns** will change with changes in storage protection needs, and transportation hazards again with consequent emergency response issues.
- The **integration of new energy sources** into the existing built infrastructure (for example new electrical energy sources, alternative heating appliances) will require changes in fire safety design/retrofit as well as public education.